SUBSTITUTE SPECIFICATION CONTAINING
ALL CHANGES SUBMITTED IN PRELIMINARY AMENDMENT

GKNG 1276 PCT

TWIN-BALL JOINT

Background

[0001] The invention relates to a constant velocity joint in the form of a twin-ball joint. Such joints have the following characteristics: an outer joint part which comprises a first longitudinal axis L12 as well as an attaching end and an aperture end positioned axially opposite one another, and which comprises outer ball tracks (22); an inner joint part which comprises a second longitudinal axis L13 and attaching means for a shaft pointing towards the aperture end of the outer joint part, and which comprises inner ball tracks; the outer ball tracks and the inner ball tracks form pairs of tracks with one another which each accommodate balls; circumferentially adjoining pairs of tracks comprise center lines of the outer and inner ball tracks which, when the longitudinal axes L12, L13 are aligned, are positioned in planes E, E' which extend parallel relative to one another and are symmetric relative to the longitudinal axes; and a ball cage positioned between the outer joint part and the inner joint part and comprising circumferentially distributed cage windows which each accommodate pairs of balls of adjoining pairs of tracks positioned in parallel planes.

[0002] When assembling fixed joints it is common practice first to insert the outer joint part, the ball cage and the inner joint part into one another and then the balls while over-articulating the joint so to speak, i.e.

articulating the inner joint part and outer joint part relative to one another in such a way that each cage window of the cage guided on to half the articulation angle between the inner joint part and the outer joint part emerges from the outer joint part. Such over-articulation results in that those balls which have already been mounted and which are not positioned in the articulation plane nor in a plane extending through the ball cage axis which plane is positioned perpendicularly relative to the articulation plane are displaced in the circumferential direction of their cage windows. The greater the angle of articulation, the greater the circumferential length of the respective cage windows has to be. Lengthening the cage windows results in a reduction in the width of the webs between the cage windows. This, in turn, results in a reduction in the strength of the cage, which is undesirable.

[0003] For a constant velocity fixed joint whose pairs of tracks are positioned in radial planes and widen jointly towards the aperture of the outer joint part, it is known from U.S. Patent No. 5,509,856 to propose a cage which comprises cage windows positioned opposite one another in a radial plane and having a first smaller circumferential length as well as cage windows whose centres are positioned outside said radial plane and a plane extending perpendicularly relative thereto and which comprise a second greater circumferential length.

Summary Of The Invention

[0004] The present invention provides an improved constant velocity joint in the form of a twin-ball joint whose cage comprises an increased strength. Specifically, the ball cage comprises circumferentially distributed cage windows which each accommodate pairs of balls of adjoining pairs of tracks positioned in parallel planes E, E', and the circumferential length X2 of second cage windows for second pairs of balls is smaller than the circumferential length X1 of first cage windows for first pairs of balls. This

permits a method of assembly wherein, first, first pairs of balls are mounted one after the other in first cage windows and wherein then second pairs of balls are mounted one after the other in the second cage windows. For mounting said second pairs of balls in the second cage windows there is required a smaller circumferential length of the respective cage windows than needed for the movement of the first pairs of balls in the first cage windows during the mounting of the second pairs of balls. As a result of this and by halving the number of windows to half the number of balls and by aligning adjoining pairs of tracks relative to planes E, E' extending parallel relative to one another, there is achieved a widening of the webs between the ball windows and thus an increase in the cage strength.

[0005] The outer joint part, at its attaching end, comprises a joint base with an attaching journal or even a flange face with a further second aperture positioned opposite the first aperture.

[0006] The advantages of the invention are particularly obvious in joints with a larger number of balls, i.e. with eight or ten balls, in the case of which the web width of prior art joints is particularly reduced. The invention can be applied to joints whose number of balls can be divided by four. For arranging the first pairs of tracks and the second pairs of tracks of joints with different numbers of balls, reference is made to the following description of the drawings.

Brief Description Of The Drawings

[0007] Preferred embodiments of the invention are illustrated in the drawings and will be described below.

[0008] Figure 1 is a longitudinal section through an inventive joint.

[0009] Figure 2 shows the joint according to Figure 1 in a cross-section through the ball cage

a) in accordance with the invention,
b) according to the state of the art.

[0010] Figure 3 shows an inventive joint during different assembly phases

a) in a side view
b) in an axial view of the joint aperture
c) in a side view of the ball cage and the inner joint part
d) in an axial view of the cage and the inner joint part.

Detailed Description Of The Drawings

[0011] Figure 1 is a longitudinal section through an inventive joint 11 which is shown to comprise an outer joint part 12 with a base 20 and a joint aperture 21 as well as an inner joint part 13 with an inner aperture 28 for a shaft journal to be inserted into same. A shaft journal 27 is formed-on to the base 20 of the outer joint part. The section shown extends parallel relative to the longitudinal axes L12 of the outer joint part and L13 of the inner joint, which can be seen later. In said section, it is possible to identify outer ball tracks 22_1, 22_2 in the outer joint part 12 and inner ball tracks 23_1, 23_2 in the inner joint part 13. Said tracks form pairs of tracks 22_1, 23_1, 22_2, 23_2 in which there run balls 14_1, 14_2. In the joint center plane EM in which there are positioned the ball centers with corresponding longitudinal axes L12, L13,the pairs of tracks widen from the aperture 21 to the base 20. A ball track design which is mirror-symmetric relative to the joint center plane EM – as compared to the ball tracks shown here – is also conceivable. The balls are held by a ball cage 16 in a common plane which, in this case, corresponds to the joint center plane EM. The balls are received by windows in the ball cage 16 of which there are shown first windows 18_1, 18_2.

[0012] The two illustrations of Figure 2 will be described jointly below. Figure 2a shows a joint according to the invention and Figure 2b a joint according to the state of the art. The cross-sectional plane shown corresponds to the section plane B-B of Figure 1.

[0013] Again, the joint 11 is shown to comprise the outer joint part 12 and the inner joint part 13 with outer ball tracks and inner ball tracks in which there are received pairs of balls. Between the joint components it is possible to see the ball cage 16 with cage windows. The sectional plane A-A as shown in the illustrations is at the same time one of the planes E_1, E_1' in which there extend the center lines of pairs of tracks which receive the balls 14, 14' of the second pairs of balls. The planes E_1, E_1' are positioned perpendicularly relative to the drawing plane, i.e. parallel to and symmetrically relative to the longitudinal axes L12, L13, with corresponding longitudinal axes. In contrast to the joint according to the state of the art according to Figure 2b wherein the circumferential length of all cage windows 18 is the same, with the web width A1 of the webs 17 between the individual cage windows being the same relative to one another and greatly reduced, the joint in accordance with the invention according to Figure 2a is shown to comprise cage windows 18 with a circumferential length X1 and first pairs of balls 14, 14' and second cage windows 19 with a smaller circumferential length X2 and second pairs of balls 15, 15'. As will be explained below, first the longer cage windows 19 with the circumferential length X1 are provided with first balls 15 and then the second cage windows 18 having the shorter circumferential length X2 are provided with the second balls 14. By reducing the circumferential length of the cage windows 18, the circumferential length of the webs increases on one side, so that there is obtained a web width A1 > A2. In each case, said increase takes place on one side of each of the webs shown here, so that the strength of the cage as a whole is uniformly increased.

[0014] The different views and illustrations of Figure 3 show the final phase of the assembly of the joint in the course of which the inner joint part 13 and the ball cage 16 are articulated relative to the outer joint part 12, with the situation of the so-called over-articulation also being shown wherein one cage window emerges from the outer joint part in such a way that the balls 14 can be inserted into the cage windows 18 and into the inner ball grooves 23. The cage window emerging here is a second cage window 18 with a shorter circumferential length X2. As can be seen in Figure 3c, when over-articulating the joint, the already mounted first balls 15 are displaced in the longer cage windows 19 until they abut, with the length X1 of said cage windows 19 being determined by the dimension of over-articulation, which is necessary to be able to insert the balls 14 into the shorter cage windows 18. As can be seen in Figure 3b, only the short length X2 of the cage windows 18 is required for directly inserting the balls 14 into the cage windows 18 and the inner ball grooves 23 which are positioned close to the articulation plane. Prior to the final assembly stage shown here, the opposed balls 14 had been inserted into their cage windows 18 in the same way. Prior to that, in two first assembly stages, under conditions of over-articulation, the first cage windows 19 were provided in the same way with balls 15, with the circumferential length of the second cage windows as yet without balls 15 at that stage, being of no significance for said assembly stages.